

CONSTRUCTION STANDARD SPECIFICATION

SECTION 16742

INTRA-BUILDING TELECOMMUNICATIONS SYSTEM

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CONSTRUCTION STANDARD SPECIFICATION

SECTION 16742

INTRA-BUILDING TELECOMMUNICATION NEW SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

- A. Section 16742 covers the products to be used and the specifications for executing intra-building telecommunication cabling both for new construction and remodeling projects at Sandia National Laboratories, New Mexico (reference to Sandia/NM here after refers to this site). The specification is addressed to any contractor selected to perform such work at Sandia. All work must be performed as described in this specification, on Sandia-supplied drawings, and in the contract documents. In general,
 - 1. The cable system must be installed following manufacturer's instructions and following the design in its entirety as described in Sandia/NM's Statement of Work, on drawings, and in this construction standard specification.
 - 2. Supply all products, tools, consumables, and test equipment needed to complete the project described in the Statement of Work. Some products may be Sandia/NM-furnished material (SFM) as noted in the contract documents and on the drawings.
- B. Definitions of Cabling Systems
 - 1. Intra-Building Cable: Telecommunication cable within a building.
 - 2. Inter-Building Cable: Telecommunication cable between buildings.
 - 3. AVAYA Technologies: A company formerly named Lucent that certifies telecommunication personnel and equipment in the United States.
- C. Safety issues
 - 1. Consult with the Sandia/NM-delegated representative (SDR) to ascertain whether any areas are defined as confined spaces according to OSHA 29 CFR Part 1910 requiring special permits for access, and if so, obtain the permits.

Comply with requirements of OSHA 29 CFR Part 1910, Section 146 when working in permit-required confined spaces; see section 1.02 C., References.

2. Install all cable in accordance with the National Electrical Code (NEC) 70 of the National Fire Protection Association (NFPA), see section 1.02 B., References.
3. The location of hazardous materials areas is shown on the drawings, and the following directions must be followed in such areas:
 - a. Avoid disturbing hazardous materials in making acceptable modifications of raceway routing, mounting equipment, and other work.
 - b. Do not mount conduit, equipment, hangers, and other accessories on surface materials known to contain asbestos or other hazardous materials without written authorization from the SDR outlining the method of installation.
 - c. If hazardous materials or conditions not shown on the drawings are encountered, stop work immediately and vacate the area. Immediately notify the SDR of the condition and do not enter the area or work in the area until receiving written authorization from the SDR.
- D. The drawings, which Sandia/NM supplies, delineate the intra-building cable system by locations of intermediate distribution rooms (IDR), user outlets, rack frame, and cabinet locations. Sandia/NM now supplies only one set of drawings both for RED and BLACK data systems for new construction. RED and BLACK data systems will be fiber only and will share the same conduit system. Voice outlet locations and termination frames will also be on this set of drawings.

Raceway and cable routing shown on drawings are not intended to show all support or mounting hardware, or raceway bends, kicks, offsets, and couplings.
- E. The contract documents describe which portions of the drawing package are applicable to this particular project. You must address any discrepancies between contract documents and the drawing package with the SDR and Sandia's Telecommunication Operations Department.
- F. Variations: Drawings and other contract documents indicate the basic location, arrangement, and routing of equipment and components. If you wish to make any variations from these specifications based on the site investigation outlined in section 3.01 or for other reasons,
 1. Submit a detailed description of proposed improvements and modifications to the SDR for review. Include drawings, manufacturer's literature, and a detailed description of functional improvements.
 2. Do not incorporate modifications and associated work until receiving written approval from the SDR.
- G. The project may contain RED [Sandia Classified Network (SCN)], BLACK [Sandia Restricted Network (SRN)], Sandia Open Network (SON), and telephony systems.

RED systems require special security procedures. Contact Sandia's Network Control Center (NCC) at (505) 844-8670 to request the Protected Transmission System (PTS) Site Manager for information supplementing this specification. All

work performed on RED systems must comply with United States Department of Energy (DOE) requirements, which may or may not be explicitly indicated or noted in the contract documents for the project.

- H. Contractor-furnished material and/or SFM may be used as detailed in the Statement of Work and/or elsewhere in contract documents for the project.
- I. In addition to the requirements stated here, the following specifications must also be followed in performing this work:
 - 1. Section 01065, "Environment, Safety and Health for Construction Contracts."
 - 2. Section 01330, "Submittal Procedures."
 - 3. Section 16001, "Electrical Work."

1.02 REFERENCES

Following are references that must be used in performing work for Sandia. The most current version shall be used.

- A. Electronics Industry Association/ Telecommunications Industry Association. Commercial Building Telecommunications Cabling Standard [TIA/EIA-568-A-95]. Oct. 1, 1995. (The URL for the association is <http://www.tiaonline.org>)

The TIA/EIA-568-A consists of six publications:

- 1. Commercial Building Telecommunications Cabling Standard [ANSI/TIA/EIA-568-A-95]
- 2. Propagation Delay and Delay Skew Specifications for 100 ohm 4-pair Cable [ANSI/TIA/EIA-568-A-1-97]
- 3. Correction and Additions to TIA/EIA-568-A [ANSI/TIA/EIA-568-A-2-98], Addendum No. 3 to TIA/EIA-568-A [ANSI/TIA/EIA-568-A-3-98]
- 4. Production Modular Cord NEXT Loss Test method for unshielded Twisted-Pair Cabling [ANSI/TIA/EIA-568-A-99]
- 5. Transmission Performance Specifications for 4-pair 100 Ohm Category 5e Cabling [ANSI/TIA/EIA-568-A-5-2000]
- 6. Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems [TIA/EIA TSB 67], Oct. 1, 1995.
- B. United States Department of Energy. Telecommunications Security Manual [DOE TSM 200.1-1]. March 15, 1997. The Department of Energy has mandated that this manual will not be available to contractors, but it can be viewed at Sandia by making an appointment with the Protected Transmission System Site Manager through the Network Control Center (NCC) at (505) 844-8670
- C. Supplementary References

The publications listed below are not referenced in this specification, but are listed because they contain design and technical criteria that are pertinent to this kind of project. At any point during the project, you may be asked to demonstrate a working familiarity with each of the following standards.

1. American National Standards Institute. Detail Specification for All-Dielectric (Construction 1) Fiber Optic Communications Cable for Indoor Plenum Use, Containing Class Ia, 62.5 Micron Cladding Diameter Optical Fiber(s) [TIA/EIA-472CAAA], 1993. (The URL for the institute is <http://web.ansi.org/default.asp>)
 - a. Generic Specification for Fiber Optic Cable [TIA/EIA-4720000-A]. Nov. 1, 1993.
 - b. Safe Use of Lasers [ANSI Z136.1-2000]. June 28, 2000. (revision of ANSI Z136.1-1993)
 - c. Sectional Specification for Fiber Optic Communications Cable for Indoor Use [TIA/EIA-472C000-A]. Nov. 1, 1993.
2. Building Industry Consulting Service International (BICSI). (The URL for the organization is <http://www.bicsi.org>)
 - a. Telecommunications Distribution Methods Manual (TDMM). 9th edition, 2000.
 - b. LAN and Internetworking Design Manual. 3rd edition 1999.
3. Electronics Industries Association/Telecommunications Industries Association (EIA/TIA). (The URL: http for the TIA is // <http://www.tiaonline.org>)
 - a. Administration Standard for the Telecommunications Infrastructure of Commercial Buildings [606]. Feb. 1, 1993.
 - b. Commercial Building Grounding and Bonding Requirements for Telecommunications [607]. Aug. 1, 1994.
 - c. Commercial Building Standard for Telecommunications Pathways and Spaces [596-A]. Feb. 1, 1998.
 - d. Fiber Optic Component Testing [455 Series]. March 1, 1980.
 - e. Optical Fiber Systems Test Procedures (OFSTP) [526 Series]. Sept. 16, 1992.
 - f. Residential Telecommunications Wiring Standard [570-A]. Oct. 1, 1999.
4. Insulated Cable Engineers Association, Inc. (ICEA). Communications Wire & Cable for Premises Wiring [S-80-576]. 1994. (The URL for the association is <http://www.icea.net/>)

5. Telcordia Technologies, Inc. (The URL for the company is <http://www.telcordia.com/search/index.html>)
 - a. Generic Criteria for Optical Power meters [TR-TSY-000886]. Mar. 1990.
 - b. Generic Requirements for Hand-Held Optical Power Meters [TR-NWT-001137]. Dec. 1991.
 - c. Generic Requirements for Optical Loss Test Sets (OLTS) [GR-198]. Nov. 1996.

These publications can be purchased using the following URLs:

- A National Resource for Global Standards (<http://www.nssn.org/search.html>)
- Global Engineering Documents (<http://global.ihs.com>)
- Insulated Cable Engineers Association, Inc. (<http://www.icea.net/>)
- Underwriter's Laboratories, Inc. (<http://ulstandardsinfo.net.ul.com>)

1.03 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

- A. Submit a site investigation report as described in section 3.01 below.
- B. Provide manufacturer's data for specified materials and all equipment not listed in Tables 2 and 3 of this specification.
- C. Provide a list of proposed test equipment you plan to use.
 1. Refer to Table 3 for Sandia/NM-preferred test equipment and use the equipment listed.
 2. If you choose to substitute test equipment for that listed in Table 3, obtain approval from the SDR and Sandia's Telecommunication Operations Department by submitting appropriate technical data as specified here. Use of unapproved equipment will require retesting all cable terminations at no additional cost to Sandia/NM.
 3. Provide a detailed, written description of procedures for cable placement, terminations, testing and equipment specific to testing activities for Sandia's optical fiber (OF) and copper cables.
 4. Provide complete technical specifications for OF and copper test equipment if using other than Sandia/NM-preferred equipment listed in Table 3.
 5. Provide the software revision number for test equipment using software or firmware.
 6. Provide a current copy of the manufacturer's calibration certificate for each piece of test equipment, with traceability to the National Institute of Standards and Testing (NIST) requirements.

- D. Progress Reports on Testing: For all tests performed, submit to the Telecommunication Operations Department paper copies of the Outlet Cable Test Forms within a week of performing the test. Progressive submittals on a weekly basis are required for large-scale tests lasting more than four weeks. Sandia's Telecommunication Operations Department will furnish electronic templates of documentation forms that must be used for test documentation, copies of which are in Appendix B. See 3.08 H for instructions specific to the Outlet Cable Test Form.
- E. Final Reports on Testing: Final reports confirming that cabling has been tested according to Sandia/NM requirements are due to Sandia/NM two weeks after Construction Completion. Supply to the Telecommunication Operations Department one hard copy of the Outlet Cable Test Forms and all cable charts, and one electronic copy of the final reports for each intermediate distribution room (IDR) and each main distribution room (MDR). The electronic copy must be in IBM-PC format and labeled with the test date, building number, contractor's name, and the contract/job number. See section 3.08 H for instructions on the Outlet Cable Test Forms and Appendix B for an example test form. File names shall always start with red for RED systems, black for BLACK systems followed by the user outlet number. Provide an AVAYA Technologies SYSTIMAX 20-year certification for cable terminations and testing.
- F. Quality Control Documentation
 - 1. Procedures: Before beginning construction, provide the following to the SDR:
 - a. Written, detailed procedures including techniques for securing, protecting, and dressing transitions from OF and copper cable to conductor to connector.
 - b. Written, detailed termination procedures for OF and copper conductors following AVAYA specifications.
 - c. A written company quality control policy including measures to be taken throughout the contract to ensure delivery of quality work to Sandia.
 - 2. Contractor Qualifications: Before beginning construction, provide to the Telecommunication Operations Department certification of meeting quality assurance requirements and include the following:
 - a. Proof of your status as an AVAYA Technologies Authorized Installer for Sandia.
 - b. AVAYA Technologies training certifications of all on-site personnel.
 - c. AVAYA certification for equipment, instrumentation, and supplies necessary to perform terminations.
- G. Detailed drawings for new design-build construction projects: These detailed drawings must be submitted and approved by Sandia's Telecommunication Operations Department for all projects before construction begins and must follow Sandia's Telecommunications Electrical Design Guide Standards.
- H. As-built drawings: Prepare as-built documentation and provide it to the SDR at Project Completion. The SDR will provide assistance in obtaining one set of

reference drawings. Submit dated as-built drawings to the Telecommunication Operations Department for review at two-week intervals, beginning at the project start date, or as specified elsewhere in contract documents. An electronic file shall be submitted to the Telecommunication Operations Department at the end of the project.

Note: Call attention to changes to the original drawings by circling the affected area in red.

1.04 QUALITY ASSURANCE

You the contractor must monitor quality, and quality control must be continuously maintained over manufacturers, suppliers, subcontractors, work force, site conditions, products, and services to ensure all construction is of specified quality.

1.05 WARRANTY

- A. A written statement is required guaranteeing performance of the entire installation of twisted pair cable and OF cable for a minimum period of 20 years from Construction Completion. This 20 year AVAYA warranty must be delivered to the Telecommunication Operations Department within 30 days of Project Completion.
- B. If other items supplied as part of the project have warranties that will last less than one year after Project Completion, you must supply a full parts and labor warranty for a year after acceptance.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Products (meaning any installed products or materials, for example, cabling, outlet boxes, and connectors) must meet the requirements of NFPA 70 (NEC) and, when applicable, must be approved by a nationally recognized testing laboratory.
- B. Install products in a neat and workmanlike manner, in accordance with NFPA 70 (NEC), which represents minimum acceptable quality. Compliance with this industry standard suffices except when more stringent requirements are specified in the contract and tolerances indicate higher standards or more precise workmanship.
- C. Provide products that are new and currently in production.
- D. Do not use products that have been removed from existing premises, except as specifically and expressly permitted by contract documents or the SDR.
- E. Use the products specified by standard industry names in Table 2, unless specifically noted otherwise.
- F. Products submitted for approval must be used for the purpose intended. No deviation from products listed in Table 2 will be permitted without prior written permission from Sandia's Telecommunication Operations Department.

2.02 DELIVERY, STORAGE, AND HANDLING

- A. Provide equipment necessary to handle, transport, and deliver products, including SFM, from storage site to work area.
- B. Store products in original wrappings, and protect from dirt, weather and construction work traffic.
- C. Coordinate with the SDR at least three days in advance to pick up SFM.
- D. Thoroughly inspect products for damage before taking custody, including SFM.
 - 1. Inform the SDR within one workday if SFMs are found to be damaged, and provide documentation with sufficient engineering data to confirm the defect. If optical fiber is obtained from Sandia/NM it is the contractors responsibility to perform testing to insure all fiber is undamaged before the fiber is removed from the Sandia/NM storage facility. Fiber removed from Sandia/NM storage that has not been tested and found to be damaged will be replaced at contractors cost.
 - 2. Replacement SFM materials will be supplied only after defective materials have been returned to the SDR and the defect has been confirmed.
 - 3. If SFMs are rendered unusable and the SDR determines it was because of your error or improper installation, the materials must be replaced at your expense. Return unused SFM with an inventory to the SDR immediately after product use is complete.

2.03 INTRA-BUILDING TELECOMMUNICATION CABLING AND TERMINATION COMPONENTS

- A. Copper Cable:
 - 1. Use the cable as specified by manufacturer, pair counts, part numbers, and comcodes in Table 2; substitutes will not be accepted.
 - 2. Supply cable of continuous lengths without splices on reels or in boxes.
 - 3. Follow the color codes shown in Table 1 for termination of conductors in each twisted pair cable.
 - 4. Follow the manufacturer's instructions for storage and installation.
- B. Optical Fiber Cable:
 - 1. For both multi-mode and single mode, follow the manufacturer's type, fiber counts, part numbers, and comcodes as specified in Table 2; substitutions will be not accepted.
 - 2. Supply cable on reels of continuous lengths without splices.
 - 3. Follow the manufacturer's instructions for storage and installation.

C. Termination Components:

1. Components are specified in Table 2; substitutes will not be accepted.
2. Follow the manufacturer's instructions for storage and installation.

2.04 LABELS

A. Intra-Building and Inter-Building Cables:

1. All cables must be labeled. For this, use a portable labeling system printer, Brady LS2000 or a system of equal capability approved by the SDR.
2. Missing or unclear nomenclature is not a reason not to identify cables; if nomenclature is a problem, bring it to the SDR's attention.
3. Refer to section 3.06 for details on labeling intra-building cables.

PART 3 - EXECUTION

3.01 SITE INSPECTION REPORTS

A. Do not begin construction until a detailed inspection of the existing site has been performed and a site-investigation report has been submitted to the Telecommunications Operation Department. Verify the following and include in the report that:

1. The information presented in the contract documents is correct, or
 - a. show proposed modifications and reasons for change, including specification sheets and written functional requirements to support findings.
 - b. include drawings and other data required to show variations and corrections. Drawings and this specification shall be available on site for reference during construction.
 - c. indicate the associated costs to accommodate existing site conditions.
2. You can install equipment and accomplish the work as shown in the contract documents.
3. Your installation equipment and methods must be compatible with existing conditions.
4. You have included field measurements and other data obtained during the site inspection.

B. If the SDR determines the construction schedule will be affected by information presented in site investigation report, the SDR will notify you, the contractor. You must revise the initial progress schedule and resubmit it to the SDR for review and approval.

- C. When all conflicts between contract documents and site-investigation information have been resolved, certify in writing that the site investigation has been completed and that:
 - 1. Except for items noted, the conditions shown and described in the contract documents are correct.
 - 2. Equipment can be installed, and work can be performed as specified without conflicts with existing site conditions.

3.02 TYPICAL OUTLET CONFIGURATION FOR EACH USER LOCATION

- A. Each voice outlet must include one copper cable terminated on a faceplate with an 8-pin modular jack. In addition to the copper voice outlet install, an all fiber data outlet with conduit system shall be installed for each user to include two 50-micron four-fiber MM cables (one four-fiber MM cable for RED and one four-fiber MM cable for BLACK), and two four-fiber SM cables (one four-fiber SM cable for RED and one four-fiber SM cable for BLACK). See Table 2 for product specifications. If drawings or other contract documents indicate installation of less than the above minimum capability, you must immediately notify the SDR and the Telecommunication Operations Department. Deviations from the above minimum standard must be authorized in writing from the Telecommunication Operations Department before installation.

3.03 ADDITIONAL ELECTRICAL REQUIREMENTS

- A. A 100-amp, three-phase, 120/208-volt electrical panel must be installed in each IDR. If power panel is not shown on power plans or other construction drawings, notify the SDR before construction begins.
- B. Two 20-amp 110-volt dedicated electrical circuits with 20-amp receptacles, and two 20-amp 220-volt dedicated electrical circuits with 20-amp receptacles must be installed in each communications equipment cabinet,. If the receptacles are not shown on power plans or other construction drawings, notify the SDR before construction begins.
- C. Install electrical grounding and cable tray layout per standard drawing T-1001STD.
- D. Lighting in all IDRs and MDRs must have electrical magnetic interference (EMI) filters installed.
- E. The electrical equipment listed on standard drawings must be used without substitutions. Substitutions may only be used if approved in writing by the Telecommunication Operations Department.
- F. The dedicated electrical panel in the IDR should only feed the access control system, ISDN bulk power supplies and the communications equipment cabinets. All other convenience receptacles, lighting and fan coil unit shall be fed from other electrical sources. If this requirement conflicts with other construction documents, notify the SDR before construction begins.

- G. An InfoGraphic access control system must be installed. If the access control system is not shown on construction drawings, notify the SDR before construction begins.
- H. Adhere to all standard telecommunication drawings. If standard drawings are not issued as part of the drawing package, or if the standard drawings conflict with other contract documents, notify the SDR before construction begins.

3.04 CONDUIT

- A. Conduit entrances into an IDR or MDR must be perpendicular to the cable tray or equipment cabinet (and/or ceiling). Do not use horizontal conduit entrances, unless pre-approved by the Telecommunication Operations Department in writing. Communications conduit shall not exceed 270° of bend between pull boxes. Conduit runs shall not exceed 100' without pullboxes. Special measures to protect cabling must be undertaken, in this case at the direction of the SDR. Conduits smaller than 1-1/2 inch should not be stubbed directly into the IDR. Instead, they must be routed into a backbone pullbox, which connects with larger conduits to the IDR. Conduit shall not exceed thirty percent (30%) fill for new construction. If additional cabling is installed in existing conduits do not exceed forty percent (40%) fill. A new conduit backbone shall be installed once the existing backbone is at forty percent (40%) fill.
- B. Ensure that existing conduits are clean and free of obstructions before pulling cable. All communication cables must be pulled by a Sandia approved AVAYA Value Added Reseller (VAR). Install grounding bushings on all conduits before pulling cable.
- C. Secure conduit in place with positive anchorage devices designed and sized to withstand stresses, vibration, and distortion.
- D. Ensure that concealed pathways for vertical conduit drops, such as the drops from the ceiling space to a flush-mounted junction box behind a data user outlet, are continuous conduit from inside the junction box within a wall to an accessible location, such as above a lay-in ceiling. This vertical run of conduit, whether RED communications are installed in it or not, must be continuous intermediate metal conduit, terminated with locknut and bushing inside the junction box to which the data user outlet is mounted. Consult the Sandia Protected Transmission System (PTS) Site Manager for guidance where conduit cannot be continuous without coupling. A PTS/CDIN inspector certified by the Sandia PTS site manager must inspect intermediate metal conduit before the conduit is covered up, for example, by drywall. All flush-mounted fiber user outlets with conduit behind the drywall must have a sticker indicting Tamper-indicating prismatic seals (TIPS) and or CDIN are in the wall. This sticker must be installed on the data outlet that contains terminated RED fiber and is supplied by the Telecommunication Operations Department. Surface-mounted conduit is preferred and will not require this sticker. IMC conduit must be installed in all Dowcraft walls. Dowcraft walls will be treated the same as walls covered in drywall.
- F. Red terminated fiber: TIPS must be installed by a PTS/CDIN Inspector, certified by the Sandia/NM PTS site manager, on any non-inspectable (concealed) conduit couplings and connectors. ONLY connectors and couplings rendered non-inspectable require these seals. You must install all KNOWN concealed conduit in

such a manner as to avoid use of TIPS as much as is practicable. Consult with Sandia's PTS Site Manager for alternate installation methods, which may be used after approval by the SDR. Surface-mounted conduit from the user outlet to above the lay-in-ceiling is desirable if couplings are to be used.

- G. TIPS must be installed on connectors at conduit rough-in, and on concealed couplings for example, before conduit is made non-inspectable by installation of building finishes. A certified PTS/CDIN Inspector must be present when drywall is installed or removed if it conceals conduits. In addition, existing TIPS seals may only be removed by a certified PTS/CDIN inspector. Contact Telecommunication Operations Department for inspection 48 hours prior to the removal of drywall containing TIPS or CDIN.
- H. Conduit Removal: Prior to opening up or removing any wall that has telecommunications conduit, you must check both sides of the wall for the warning sticker. If a warning sticker is located, follow the instructions on the sticker to arrange for a PTS/CDIN Certified Inspector to be present when the telecommunications conduit is initially exposed. This must be done to verify that the conditions of the installation observed by the PTS/CDIN Certified Inspector during the construction inspection (before the walls were buttoned up) have not changed.

3.05 CABLE INSTALLATION

A. Horizontally and Vertically Installed Cable

1. Do not use any cable lubricant.
2. Plan cable pulls so that the maximum number of cables required in a conduit are pulled simultaneously.
3. Route cables via conduit and pullboxes for OF data communications. Copper cable pathways for voice should be either plenum-rated cable or in conduit as identified and shown on the drawings.
 - a. Horizontal cable pathways for copper voice cabling may be exposed within the ceiling space. Horizontal cabling bridging any inaccessible area must be installed in conduit or as indicated on the drawings. Wide-base cable support clips approved for such use by a nationally recognized testing laboratory such as UL must support exposed cabling above the ceiling space at intervals of no greater than four ~ five feet on center. Exposed cabling must be routed in bundles of no more than 50 cables with runs parallel or perpendicular to walls and structural members. It must also be parallel to intersections of vertical planes and ceilings and must remain as accessible as possible after all building utilities have been installed.
 - b. All copper cable must be routed in such a manner as to avoid possible transmission interference or degradation from all EMI sources present within the ceiling spaces, plenums, floors and walls where such cabling is installed. (For example, electrical ballast in light fixtures causes EMI and this can interfere with how the cable performs.)

4. Individual voice copper cable lengths must not exceed 300 meters (984 feet) from an IDR termination frame to a Voice outlet. If a cable length exceeds this distance, notify the SDR. Do not place any cable at longer distances until directed to do so by the SDR.
 5. If deviations from drawings are required, the SDR must approve them before the affected cables are placed.
 6. Do not install more cables in conduit than 40 percent fill unless approved in writing by the SDR. All drawings must indicate conduit fill at the time of design.
 7. If indirect attachments are used, match the grip diameter and length to the cable diameter and characteristics. Reduce pulling forces to ensure that optical fibers or twisted pair copper conductors are not damaged from forces being transmitted to strength member.
 8. Do not exceed the maximum pulling tension specified by the cable manufacturer.
 9. Inspect the cable jacket carefully for defects as the cable is played off the reel.
 10. Take precautions during installation to prevent the cable from being kinked, crushed, or being mishandled.
 11. Do not exceed the minimum bend radius of the cable as recommended by the manufacturer. You are responsible for determining the minimum bend radii for cable being placed using the manufacturer's latest information. You are also required that the conduit system installation will not exceed the bend radii for cable being installed. The following minimum bend radius information is provided only as general guidance:
 - a. Short-Term No Load: 10 times outer diameter
 - b. During Installation: 20 times outer diameter
 - c. At Rest After Installation: 10 times outer diameter
 - d. Individual Buffered Fibers: 19 mm (0.75 inch)
 12. Vertical Cable Runs: Use gravity to assist in cable placement.
 - a. Start installation at the top of the run and work toward the bottom of the run.
 - b. Hand-pull if possible.
 - c. If machine assistance is required, monitor the pulling tension and do not exceed the manufacturer's specified cable-tension limits.
- B. Service loops for outside plant cable terminated within the building must be a minimum of 12 feet or as shown on drawings.

- C. Installation cable-slack requirements are intended to minimize wasting cable. After the cable has been installed, the slack must be as shown on the drawings. If it is not shown or noted, provide pre-termination cable slack as indicated below:
1. Optical Fiber Cables (before termination)
 - a. User Outlet: Not less than 1.5 meters (5 feet), or more than 2 meters (6.5 feet)
 - b. Lightguide Interconnection Unit (LIU) or fiber shelf: Not less than 2 meters (6.5 feet), or more than 2.5 meters (8.2 feet).
 2. Copper Cables, four-pair (before termination)
 - a. Telephone Outlet: Not less than 1.5 meters (5 feet), or more than 2 meters (6.5 feet)
 - b. IDR Termination Frame: All cables must be able to reach furthest frame location plus 1 meter (3.2 feet).
 3. Copper Cables greater than four-pair (before termination)

Not less than 5 meters (16.4 feet) beyond designated termination point, or more that 10 meters (32.8 feet).
- D. Cable Placement Within MDR or IDR: Route cables to termination points in the most direct possible path.
1. Cable bundles must be combed, and each cable must run parallel to other cables.
 2. After combing and straightening cables, separate cables into bundles according to routing requirements and termination points.
 3. Secure cable bundles with the hook-and-loop cable strap material listed in Table 2. Do not use cable ties manufactured from hard polymer material, such as plastic or nylon.
 4. Begin to comb, bundle and strap cables within 2 inches (51 mm) of exit from conduit. Apply cable straps to bundles at intervals no greater than 12 inches (305 mm) for the entire length of the vertical and horizontal run.
- E. Splices: Do not use splices in cabling.
1. Splices are not allowed in user drop voice cable or user drop fiber data cable. Splices are permitted in other cable types only as a last resort, subject to the following conditions:
 - a. Written approval is obtained from Sandia's Telecommunication Operations Department before the cable is spliced. (Approval is issued only on a case-by-case basis.)
 - b. The location and type of the splice is documented as part of the as-built and record drawings.

- c. Cable is retested after splicing. If the cable fails the test, notify the SDR of the problem and provide proposed procedures to eliminate the deficiency.
 - d. You correct the deficiency and retest all cables that failed test procedures.
- F. Install rack-mounted termination panels, and frames as described in contract documents. Fiber will be terminated on termination panels. Termination panels will be install in equipment cabinets. Install termination panels so that the front face of the panel is mounted eight (8) inches back from the front door of the equipment cabinet. For equipment cabinets containing electronics railing and power receptacles need to be installed so that the rail will slide from front to back without interference from the power outlets installed at the top of the cabinet. Copper voice cables will be terminated on a frame secured to the floor. The top of the termination frame will be secured to the back wall with a minimum of six (6) inches from back of frame to wall.
 - G. Install couplers, buildouts, and their support panels for optical connections at both ends of optical cables.
 - H. Install plastic user outlet box, front covers, back panels, and associated user outlet parts. Install copper faceplates for voice.
 - I. Cover optical connectors, couplers, and buildouts with clean optical dust caps of the appropriate type.
 - J. Install voice copper cabling so that it enters the IDR or MDR on the BLACK side of room and drops in above termination frame to avoid the use of cable tray.
 - K. Install RED and BLACK fiber conduit so that it first enters a RED termination equipment cabinet and a BLACK termination equipment cabinet in an IDR or MDR to avoid the use of a cable tray. If a cable tray is needed, it must be installed per standard drawings. Copper cabling is not allowed in fiber cabinets. See the details on standard drawing T-9001STD, "Backbone Raceway System Red and/or Black."

3.06 LABELING

- A. Intra-Building Cables: For copper and OF cable, label each cable at each end with a unique identifier. See Appendix A, Label and Wiring Details, Figure 3A for label specification and sequence of information.
 - 1. The floor designation for horizontal cables, and cables to desktop must be the same as the desktop outlet location.
 - 2. The floor designation for backbone cables, cables from MDR to IDR, and IDR to IDR must be the floor where the cable originates, with the origin point being the MDR.
 - 3. Sandia's Telecommunication Operations Department will provide guidance on the numbering sequence information for cabling projects.

If any of the characters change, with the exception of last four, then the numeric sequence must start at 0001.

- B. Copper Cable 110 Wiring Blocks: Floor-standing frames with 110-type wiring blocks must be used; refer to Table 2 for the product part numbers.
1. Wire punched down on 110 wiring block must be labeled on 110 wiring blocks as individual pairs.
 2. Label 110 wiring block pair count using an Excel spreadsheet template, together with a color transparent plastic strip (which is SFM) for color-coding. Refer to Appendix A, Label and Wiring Details, Figure 1.
 3. Voice 110 wiring block labels must be distinguished by the following abbreviations (see Appendix A, Label and Wiring Details):

| |
|------------------------------|
| Voice Frame Example: 836FAVC |
| VT = Voice Campus Cable |
| VM = Voice Backbone Cable |
| VP = Voice ISDN Power Cable |
| VU = Voice Horizontal Cable |

4. Provide floor-standing frames as indicated in Table 2. Groups of blocks are to be designated as campus cables, ISDN power cables, and horizontal voice cables. See Appendix A, Label and Wiring Details, Figure 2 for layout.
 5. Install an engraved label on each floor-standing frame. See Appendix A, Label and Wiring Details, Figure 3, for label specification and sequence of information.
- C. Lightguide Interconnection Unit (used only in IDRs that have existing LIUs)
1. Attach an engraved label to the door of an LIU. The LIU label must have a building number, IDR number, and numeric sequence. See Appendix A, Label and Wiring Details, Figure 4 for layout.
 2. List cable(s) and room number on the LIU together with the LIU name. See Appendix A, Label and Wiring Details, Figure 5 for layout.
 3. Provide a continuous numbering sequence for individual fibers. Number individual fiber strands in the LIU from 1 through 24, for cables with 24 fiber strands or fewer. See Appendix A, Label and Wiring Details, Figure 6 for layout.
 4. Use multiple LIUs for cables with more than 24 fiber strands, and label sequentially according to the number of fiber strands. See Appendix A, Label and Wiring Details, Figure 7.
- D. Telecommunication Cabinet: Includes floor-standing and wall-mounted cabinets.

1. Cabinet labels must have the building number, color designation for classification of network, IDR number, and sequential character. See Appendix A, Label and Wiring Details, Figure 8.
2. Label RED (SCN) and BLACK (SRN/SON) cabinets as two separate systems.
3. Center the label at the top of the front door of the cabinet.
4. Sequential characters must start over when any of the other characters change.

E. Fiber Termination Shelf

1. A single shelf may hold more than one campus, backbone or horizontal cable. Do not split a single cable between shelves. Start the numbering sequence from 1 within the shelf, and continue to the last fiber strand within that cable for cable larger than four fibers. See Appendix A, Label and Wiring Details, Figure 9 for layout.
2. Each shelf must contain either single-mode or multi-mode RED or BLACK, not both.
3. Install multiple shelves for trunk cables. Label sequentially according to the number of optical fibers.
4. Label shelves of four-fiber user cables according to the outlet and room numbers.
5. All fiber terminated in an IDR/MDR without existing LIUs must terminate in a fiber shelf installed in a telecommunications cabinet. BLACK fibers must terminate in a BLACK cabinet and RED fibers must terminate in a RED cabinet.

F. Optical Data Telecommunication Outlet:

1. Sandia's Telecommunication Operations Department will provide label sticker(s) for RED and BLACK sections of data and voice outlets.
2. Attach the red and black sticker with the preassigned numeric value to the outlet cover for the appropriate outlet. This sticker is SFM. See Appendix A, Label and Wiring Details, Figure 10 for examples of sticker placement. Do not reuse existing box numbers when outlets are moved or re-terminated.
3. Attach a Brady label to the back of the outlet plates with the same number as used in performing item 2, above. Having the number in two places will help keep the outlet cover matched to the backplate. Brady labels are not SFM.
4. Attach a label on the inside cover of the fiber outlet indicating your company name, date tested, and technician performing the testing and termination.
5. Attach a warning sticker with point-of-contact information to the outside of the cover of an outlet that is not installed with surface-mounted conduit. If Red fiber is not installed in the conduit, this warning label is not needed. The warning sticker is SFM.

G. Copper Outlet Voice:

1. Sandia's Telecommunication Operations Department will provide label sticker(s) for voice outlets.
2. Attach the sticker with the preassigned numeric value to the faceplate for the appropriate outlet. See Appendix A, Label and Wiring Details, Figure 10 for examples of sticker placement.

H. Backbone Conduit Pullbox: Install the engraved plastic label on the outside cover of the pullbox. See Appendix A, Label and Wiring Details, Figure 11.

I. Conduit: Label conduits with appropriate color-coded tape. Refer to Standard Drawing E-0006STD.

1. Install a tie-wrap label tag on each conduit end point that terminates in an IDR, MDR or is stubbed through the floor, ceiling or wall without a pullbox.
2. Hand-letter the conduit label with permanent black ink in clear block- type letters.
3. Match the label information to the information in the nearest J-Box label to which the conduit leads.

J. Note on inter-building cabling: For twisted-pair copper cables and OF cable, label each cable at each end with a unique identifier (similar to intra-building cables) with the exception that inter-building cable names must not have building numbers associated with them. (See Appendix A, Figure 3 A.)

3.07 TERMINATION OF INTRA-BUILDING TELECOMMUNICATION CABLE

A. Perform a test sample on the number of terminations designated by the SDR before beginning mass cable termination.

1. Terminate both ends of each type of cable installed.
2. Provide terminations and connections in accordance with cable and connector manufacturer's specifications.
3. Test the terminated cables and submit a test report within one week of performing the terminations to Sandia's Telecommunication Operations Department.
4. Do not proceed with termination of remaining cables until the test results have been reviewed and approved by the SDR.

B. Optical Fiber Cables: Terminate both ends of the cables. After termination, provide cable slack as shown on the drawings.

1. If not shown, cables must have the following minimum slack after successful termination.
 - a. One meter (3 feet) slack at user outlets.

- b. One and one-half meters (5 feet) at LIUs and/or fiber termination shelf.
- 2. Firmly attach Aramid yarn-strength members at both ends of the cable to prevent pullback damage.
- C. Copper Cables: Terminate both ends of cables.
 - 1. After termination, provide cables with enough cable slack for clean dress and to prevent stress and sharp bends on cables.
 - 2. Provide extra cable slack for four-pair cables to allow replacement of connectors. Provide cables greater than four-pair with a minimum of 3 meters (10 feet) slack after successful termination. Neatly store the slack in a cable tray if used, or fasten to the wall adjacent to the termination location.
 - 3. Install T568A eight-position, modular, four-pair copper connectors at user outlets and wall plates, as listed in Table 2.
 - 4. For copper, terminate four-pair cables in the IDR on 110 blocks as shown in Table 2.
 - 5. Terminate copper cables with preserved wire pair twists as specified in EIA/TIA 568A.
 - 6. Follow the manufacturer's instructions for installation.
- D. Attach eight-position modular connectors and their faceplates at user outlets into the user end of copper cables.

3.08 TESTING INTRA-BUILDING CABLING

- A. The SDR may witness field tests.
- B. Sandia may perform independent testing.
- C. You will incur all costs for retesting and consumables required by unacceptable test results.
- D. Daily Test Equipment Preparation: Properly configure cable test equipment each day before testing and include the following:
 - 1. Verify that the test equipment is still within the manufacturer's calibration warranty period.
 - 2. Verify that the test equipment is set to "auto test" and that proper cable type and associated parameters are selected.
 - 3. Verify that the test equipment's selected nominal velocity of propagation matches the cable being tested.
 - 4. Perform a self-test of test equipment to confirm its proper ability to function.

5. Connect test equipment to its matched “smart” terminator and perform an auto test to confirm that the test equipment and terminator are functioning properly.
- E. Copper Cable Tests: Use an EIA/TIA TSB-67 Level-2 tester to automatically perform the following tests.
 1. Line Mapping (End-to-End Connectivity). Check four-pair wiring for proper wiring configuration, open conductors, shorted conductors, crossed pairs, and reversed pairs.
 2. Loop Resistance (DC-Steady State). Connect an ohmmeter across one end of the cable pair with the shorting terminator across the other end of the cable pair.
 - a. Measure steady-state DC resistance and compare it to the cable manufacturer’s standard values.
 - b. Values greater than allowed resistance are considered to have failed, and values smaller than allowed resistance are considered to have passed.
 3. Attenuation: Transmit several signals at increasing frequencies across each conductor and then:
 - a. Measure the signal loss in units of decibels (dB).
 - b. Measure test frequencies and permitted dB loss values at each test frequencies.
 - c. Refer to loss values specified in EIA/TIA 568A.
 4. Cable Length: Record the cable length from either the length markings on the cable jacket or from hand-held multi-function test equipment incorporating time-domain reflectometer circuitry.
 5. Capacitance: Test each twisted pair with a capacitance meter.
 - a. Test the opposite end of the twisted pair for an open circuit.
 - b. Pass test results must yield capacitance within 2 percent of the cable manufacturer’s specification.
 6. Near-End Crosstalk: Measure both the outlet and distribution end of the link.
 - a. The worst pair of cable with near-end crosstalk must be measured in dB.
 - b. Test frequencies and permitted worst pair dB crosstalk values at each of the test frequencies are specified in EIA/TIA 568A for cable (pending).
 7. The result of each test is either “pass” or “fail.”
 8. Repair or replace and retest failed cables until passing results are achieved.
 9. Complete “Test and Chart Forms” to record cable lengths, test data, location, and calculation results; see Appendix B, Cable Test Forms.

- F. Preparing Optical Fiber Test Equipment: Properly adjust OF test equipment before use.
 - 1. Follow the equipment manufacturer's detailed instruction manual.
 - 2. Calibrate variable unit adjustments on test equipment to match the cable manufacturer's cable transmission parameters.
- G. Optical Fiber Cable and Component Test: Use test equipment listed in Table 3, or Sandia-approved equivalent (only the Telecommunication Operations Department may give such written approval) and perform the following inspection and tests for OF cable. Properly clean the optical connector end faces before connector contact is made for testing or circuit connection.
 - 1. Optical Fiber Cable Length Measurement: Record cable length (in feet) from either length markings on the cable jacket or from optical time-domain reflectometer (OTDR) measurements on the "Outlet Cable Test Form."
 - 2. Optical Fiber Connector Validation Test: Inspect each OF connector assembly with 400X visual inspection.
 - a. Reject the connector assembly if visible imperfection penetrates the fiber core or if the imperfection risks future damage to the core or mating connector's surface.
 - b. Reject the connector assembly if the connector loss displayed does not meet the manufacturer's specifications or is not in accordance with 3.07 dB (worst-case test values).
 - c. Reject the connector assembly if the connector reflectance causes a link return to exceed acceptable link return loss.
 - d. Replace or repolish rejected connector assemblies and retest until acceptable measurements are obtained.
 - 3. Optical Reference Level Measurements
 - a. Connect the optical source to the power meter with 2- to 3-meter jumper cables that have transmission characteristics identical to the optical link being measured.
 - b. Record optical power levels in dBm after operational stabilization; primarily after ambient thermal conditions are reached.
 - c. Repeat this procedure during the measurement process to verify the integrity of OF test jumpers and the optical source.
 - d. Record the optical source and power meter serial numbers of units used on each outlet cable test form in the test equipment section.
 - 4. Optical Link Attenuation Measurements: Measure optical link attenuation after both ends of the OF have been terminated and mounted into coupler panels.

- a. Record and measure the link attenuation with an optical source and power meter.
 - b. Connect the source at one end of the optical link and connect the power meter to other end.
 - c. Record the power received in dB for each wavelength.
 - d. Reverse the location of both source and power meter, and repeat the test.
 - e. Calculate the average recorded power levels for each wavelength and record it in dB.
 - f. Complete the "Test and Chart Forms" to record cable lengths, test data, location, and calculation results. See Appendix B, Cable Test Forms.
5. Optical Link Return Loss Measurement: Measure and record the optical link return measurement for single-mode optical links.
- H. Progress Reports: Submit one hard copy of the completed "Outlet Cable Test Forms" beginning one week after cable termination construction commences and continuing until project completion. Group weekly submittals by the name of the person performing the terminations, with the company name in the miscellaneous note section. Reports are due to Sandia's Telecommunication Operations Department by 4:00 p.m. each Friday.

3.09 ACCEPTANCE

- A. Optical fiber cable acceptance values are derived from approximately seventy percent (mean plus or minus one standard deviation) of component tolerances. Values shown below represent the worst-case acceptability. Typical results should approach the manufacturer's published statistical averages.
- B. Worst-case test values, as shown in Appendix B, Optical Fiber Cable Test Forms, are derived from the following formula:
1. Worst-Case Acceptable Multi-Mode Optical Link Attenuations:
 - a. 2 SC® connectors plus 300 ft. optical cable

$$= (2 \times 0.55 \text{ dB}) + (0.09 \text{ km} \times 3.4 \text{ dB/km})$$

$$= 1.1 \text{ dB} + 0.31 \text{ dB}$$

$$= 1.41 \text{ dB}$$
 1.4 dB for 850 nm
 1.2 dB for 1300 nm
 - b. 2 LC® connectors plus 300 ft. optical cable

$$= (2 \times 0.2 \text{ dB}) + (0.09 \text{ km} \times 3.4 \text{ dB/km})$$

$$= 0.4 \text{ dB} + 0.31 \text{ dB}$$

$$= 0.71 \text{ dB}$$
 0.7 dB for 850 nm

0.5 dB for 1300 nm

The link attenuation is for multi-mode fiber cable lengths based on 300 ft. 62.5-micron fiber (used only in facilities that have existing 62.5 to the desktop) must not exceed 300 ft. 50-micron Lazerspeed 300 (used in new facilities and major remodels) may be installed up to 984 ft. Attenuation for 50-micron will differ from above in cables installed at greater than 300 ft. It is your responsibility to understand the manufacture's allowable attenuation of such cables.

2. Worst-Case Acceptable Single-Mode Optical Link Attenuations:

- a. 2 ST® II connectors plus 300 ft. optical cable

$$= (2 \times 0.55 \text{ dB}) + (0.09 \text{ km} \times 0.4 \text{ dB/km})$$

$$= 1.1 \text{ dB} + 0.04 \text{ dB}$$

$$= 1.14 \text{ dB}$$

1.1 dB for both 1310 and 1550 nm

- b. 2 SC® connectors plus 300 ft. optical cable

$$= (2 \times 0.55 \text{ dB}) + (0.09 \text{ km} \times 0.4 \text{ dB/km})$$

$$= 1.1 \text{ dB} + 0.04 \text{ dB}$$

$$= 1.14 \text{ dB for both 1310nm and 1550nm}$$

- c. 2 LC® connectors plus 300 ft. optical cable

$$= (2 \times 0.2 \text{ dB}) + (0.09 \text{ km} \times 0.4 \text{ dB/km})$$

$$= 0.4 \text{ dB} + 0.04 \text{ dB}$$

$$= 0.44 \text{ dB for both 1310nm and 1550nm}$$

3. Worst-Case Acceptable Optical Link Return Loss:

- a. 2 ST® II connectors plus 300 ft. optical cable

$$= 40 \text{ dB for both 1310 and 1550 nm}$$

- b. 2 LC® connectors plus 300 ft. optical cable

$$= 45 \text{ dB for both 1310 and 1550 nm}$$

The link attenuation is for single-mode fiber cable lengths based on 300 ft. Single-mode fiber (used only in facilities that have existing single-mode to the desk top) must not exceed 300 ft. Attenuation for single-mode fiber used for campus-wide backbone will differ from the above. In cables installed at greater than 300 ft. It is your responsibility, to understand the manufacture's allowable attenuation of such cables.

TABLE 1

Cable Termination Color Codes

| 4 PAIR CABLE | 25 PAIR CABLE | 100 PAIR CABLE | | | |
|----------------|------------------|----------------|----------|----------|----------|
| | | BINDER | | | |
| | | BLUE | ORANGE | GREEN | BROWN |
| 1 WHITE/BLUE | 1 WHITE/BLUE | 1 WH/BL | 26 WH/BL | 51 WH/BL | 76 WH/BL |
| 2 WHITE/ORANGE | 2 WHITE/ORANGE | 2 WH/OR | 27 WH/OR | 52 WH/OR | 77 WH/OR |
| 3 WHITE/GREEN | 3 WHITE/GREEN | 3 WH/GN | 28 WH/GN | 53 WH/GN | 78 WH/GN |
| 4 WHITE/BROWN | 4 WHITE/BROWN | 4 WH/BN | 29 WH/BN | 54 WH/BN | 79 WH/BN |
| | 5 WHITE/SLATE | 5 WH/SL | 30 WH/SL | 55 WH/SL | 80 WH/SL |
| | 6 RED/BLUE | 6 R/BL | 31 R/BL | 56 R/BL | 81 R/BL |
| | 7 RED/ORANGE | 7 R/OR | 32 R/OR | 57 R/OR | 82 R/OR |
| | 8 RED/GREEN | 8 R/GN | 33 R/GN | 58 R/GN | 83 R/GN |
| | 9 RED/BROWN | 9 R/BN | 34 R/BN | 59 R/BN | 84 R/BN |
| | 10 RED/SLATE | 10 R/SL | 35 R/SL | 60 R/SL | 85 R/SL |
| | 11 BLACK/BLUE | 11 BK/BL | 36 BK/BL | 61 BK/BL | 86 BK/BL |
| | 12 BLACK/ORANGE | 12 BK/OR | 37 BK/OR | 62 BK/OR | 87 BK/OR |
| | 13 BLACK/GREEN | 13 BK/GN | 38 BK/GN | 63 BK/GN | 88 BK/GN |
| | 14 BLACK/BROWN | 14 BK/BN | 39 BK/BN | 64 BK/BN | 89 BK/BN |
| | 15 BLACK/SLATE | 15 BK/SL | 40 BK/SL | 65 BK/SL | 90 BK/SL |
| | 16 YELLOW/BLUE | 16 Y/BL | 41 Y/BL | 66 Y/BL | 91 Y/BL |
| | 17 YELLOW/ORANGE | 17 Y/OR | 42 Y/OR | 67 Y/OR | 92 Y/OR |
| | 18 YELLOW/GREEN | 18 Y/GN | 43 Y/GN | 68 Y/GN | 93 Y/GN |
| | 19 YELLOW/BROWN | 19 Y/BN | 44 Y/BN | 69 Y/BN | 94 Y/BN |
| | 20 YELLOW/SLATE | 20 Y/SL | 45 Y/SL | 70 Y/SL | 95 Y/SL |
| | 21 VIOLET/BLUE | 21 V/BL | 46 V/BL | 71 V/BL | 96 V/BL |
| | 22 VIOLET/ORANGE | 22 V/OR | 47 V/OR | 72 V/OR | 97 V/OR |
| | 23 VIOLET/GREEN | 23 V/GN | 48 V/GN | 73 V/GN | 98 V/GN |
| | 24 VIOLET/BROWN | 24 V/BN | 49 V/BN | 74 V/BN | 99 V/BN |
| | 25 VIOLET/SLATE | 25 V/SL | 50 V/SL | 75 V/SL | 100 V/SL |

TABLE 2
Intra-Building Cabling Parts List

| Item # | Item Description | AVAYA Part No. | AVAYA Comcode |
|--------|---|---------------------|---------------|
| 1 | 600B Combination Shelf Panel e/w 24 Singlemode ST Couplings (used for Truck fibers) | 24ST1SM-EW | 700 006 422 |
| 2 | 600BLS Combination Shelf e/w 24 SC adapters (used for RED 50 micron LazrSPEED 300 fibers) | 600BLS/MM/SC-24 | 108 565 763 |
| 3 | 600BLS Combination Shelf e/w 48 LC adapters (used for BLACK 50 micron LazrSPEED 300 fibers) | 600BLS/MM/LC-48 | 108 565 755 |
| 4 | Rack Mount Optical Dist. Panel for MDR | LST1U-072/7 | 105 335 871 |
| 5 | Coupling Panel for LST1U (for ST connector) | 1000ST (pack of 12) | 105 428 486 |
| 6 | Jumper Retainer for LST1U | JR1A | 104 411 277 |
| 7 | Cable Clamp | CLMP-12A2 | 106 230 337 |
| 8 | Wall Mount Optical Termination Panel | 200A LIU | 105 535 926 |
| 9 | Coupling Panel for 200A LIU in IDR (for ST connector) | 10A | 104 141 858 |
| 10 | Vertical Trough for 200A LIU in IDR | 2A8 | 106 295 520 |
| 11 | Horizontal Trough for 200A LIU in IDR | 2A6 | 106 497 761 |
| 12 | MM STII Connector | P2020C-125 | 105 143 911 |
| 13 | MM STII Coupler | C2000A-2 | 104 148 028 |
| 14 | MM LC Connector | P1000A-Z-125 | 107 764 292 |
| 15 | MM LC Fiber Adapter for use in 600BLS | C1001B-2 | 700 002 355 |
| 16 | MM SC Connector | P6200A-Z-125 | 700 007 040 |
| 17 | MM SC Fiber Adapter for use in 600BLS | C600A-5 | 108 009 416 |
| 18 | MM LC Fiber Adapter for use in user outlet | M81LC-029 | 107 782 641 |
| 19 | MM SC Fiber Adapter for use in user outlet | C6061A-4-LS | 108 662 858 |
| 20 | MM Cable - 4 Fiber, Indoor Riser Indoor Riser (for use in existing building that have 62.5 to the desktop) | LGBC-004D-LRX | 106 291 008 |
| 21 | MM Cable - 12 Fiber, 62.5 Indoor Riser (for use in existing building that have 62.5 to the desktop) | LGBC-012D-LRX | 106 291 073 |
| 22 | MM Cable - 24 Fiber, 62.5 Indoor Riser (for use in existing building that have 62.5 to the desktop) | LGBC-024A-LRX | 106 058 142 |
| 23 | MM Cable - 48 Fiber, 62.5 Indoor Riser (for use in existing building that have 62.5 to the desktop) | LGBC-048A-LRX | 107 531 360 |
| 24 | MM Cable - 72 Fiber, 62.5 Indoor Riser (for use in existing building that have 62.5 to the desktop) | LGBC-072A-LRX | 107 531 378 |
| 25 | MM Cable - 4 Fiber, 50 micron LazrSPEED 150 Indoor Riser (for use in new building and buildings that are remodeled that don't have existing fiber to the desktop, cable not to exceed 150 meters) | ABC-004D-ZHX | 700 009 822 |
| 26 | MM Cable - 4 Fiber, 50 micron LazrSPEED 300 Indoor Riser (for use in new building and buildings that are remodeled that don't have existing fiber to the desktop) | 5200-004A-ZRAQ | 700 208 135 |
| 27 | MM Cable - 24 Fiber, 50 micron LazrSPEED 300 Indoor Riser (for use in new building and buildings that are remodeled that don't have existing fiber to the desktop) | 5300-024A-ZRAQ | 700 208 168 |
| 28 | MM Cable - 48 Fiber, 50 micron LazrSPEED 300 Indoor Riser (for use in new building and buildings that are remodeled that don't have existing fiber to the desktop) | 5300-048A-ZRAQ | 700 208 218 |
| 29 | SM STII Connector | P3020A-Z-125 | 106 812 258 |
| 30 | SM ST Coupler | C3000A-2 | 105 271 142 |

| Item # | Item Description | AVAYA Part No. | AVAYA Comcode |
|--------|--|------------------------|--------------------|
| 31 | SM LC Connector | P1101A-Z-125 | 107 764 300 |
| 32 | SM LC Fiber Adapter | C1101A-2 | 108 072 489 |
| 33 | SM SC Connector | Systimax P6001 B-7-125 | Systimax 760007112 |
| 34 | SM SC Coupling | Systimax C6060A-4 | Systimax 700004815 |
| 35 | SM ST Coupler Buildout Block (LIU) | A3002 | 106 709 140 |
| 36 | SM ST Coupler Buildout (LIU) | A3070 - 0 dB | 106 795 354 |
| 37 | SM ST Coupler Buildout (LIU) | A3070B - 5 dB | 106 795 362 |
| 38 | SM ST Coupler Buildout (LIU) | A3070D - 10 dB | 106 795 370 |
| 39 | SM ST Coupler Buildout (LIU) | A3070F - 15 dB | 106 795 388 |
| 40 | SM ST Coupler Buildout (LIU) | A3070H - 20 dB | 106 795 396 |
| 41 | SM Cable - 4 Fiber, Indoor Riser | LGBC-004D-SRX | 106 291 016 |
| 42 | SM Cable - 12 Fiber, Indoor Riser | LGBC-012D-SRX | 106 291 081 |
| 43 | SM Cable - 24 Fiber, Indoor Riser | LGBC-024A-SRX | 107 508 327 |
| 44 | SM Cable - 48 Fiber, Indoor Riser | LGBC-048A-SRX | 107 531 345 |
| 45 | SM Cable - 72 Fiber, Indoor Riser | LGBC-072A-SRX | 107 531 352 |
| 46 | SM Cable - 24 Fiber, Outdoor, 4DNX, BXD | 4DNX-024-BXD | 105 929 384 |
| 47 | SM Cable - 48 Fiber, Outdoor, 4DNX, BXD | 4DNX-048-BXD | 105 929 509 |
| 48 | SM Cable - 72 Fiber, Outdoor, 4DNX, BXD | 4DNX-072-BXD | 105 929 624 |
| 49 | Duct Liner- 3 cell (MAXCELL) | | TVC Communications |
| 50 | Copper Cable, Cat. 5E, Blue Plenum | 2061004BBL W 1000 | 106 946 825 |
| 52 | Copper Cable, Cat. 5E, Slate Riser | 1061004CSL W 1000 | 106 836 950 |
| 52 | UTP Frame, RED, w/12-110 Blocks (for use in existing building that have RED Copper to the desktop) | XLBET - Red | 107 065 591 |
| 53 | UTP Frame, BLK, w/12-110 Blocks | XLBET - Black | 105 158 182 |
| 54 | UTP Frame, Bldg Entr, w'Prot. 300pr | XLBET,blk,9-110's | 107 256 190 |
| 55 | UTP Frame, Bldg Entr, W/Prot. 600pr | XLBET,blk,10-110's | 107 119 091 |
| 56 | Protector Units (old "S" type self-heal)-Blk | 3C1S (Black) | 105 514 756 |
| 57 | Protector Units ("S" self-heal)-Blk for Voice | 4C1S (Black) | 104 386 545 |
| 58 | UTP, 300 pair 110 block | 110AW2-300 | 107 059 917 |
| 59 | Surface Mount User Outlet, AVAYA White multimedia outlet | M40A1-B-262 (Outlet) | 107 992 927 |
| 60 | ST Insert (8-port) - white | M40ST8-B-262 | 107 239 485 |
| 61 | LC (RJ-45) Insert (4-port) - white | M40RJ4A-262 | 108 004 268 |
| 62 | SC (RJ-45) Insert (4-port) - white | M40DSC4-262 | 107 239 493 |
| 63 | Blank Insert - white | M40B-262 | 107 697 989 |
| 64 | Modular Flush-Mount Faceplate For Voice - white | M10L-262 | 108 258 427 |
| 65 | RJ45 Module, T568A MPS 100 Power Sum, Cat. 5 | MPS100EI | 108 232 2919 |
| 66 | Velcro "One-Wrap" Cable Ties, 200 yd Spool | One-Wrap (Black) | Velcro 179914 |
| 67 | Equipment Rack 36", RED, 84 in. H (19 in. rail) | EDP-4900-SL | EDP |
| 68 | Equipment Rack 36", BLK, 84 in. H (19 in. rail) | EDP-4900-SL2 | EDP |
| 69 | Equipment Rack wall mount 36", BLK, 30 in. H (19 in. rail) | EDP-WMSD362430B | EDP |
| 70 | Equipment Rack wall mount 36", RED, 30 in. H (19 in. rail) | EDP-WMSD362430R | EDP |
| 71 | Concrete Floor Kit | | EDP |
| | | | |

NOTE:

1. If desired parts are not shown on this table, contact Sandia's Telecommunication Operations Department for parts to be used.
2. Some part numbers and comcodes may require vendor cross-referencing to new AVAYA numbers from older AT&T numbers.
3. Outside plant copper cables may now be produced by Cable Systems International (CSI), rather than AVAYA Technologies. Use CSI cable, ANMA filled ALPETH DEPIC (type). Consult Sandia's Telecommunication Operations Department for additional information.
4. Refer to standard drawings for additional components not listed in this table.

TABLE 3

Sandia Preferred Test Equipment

| Equipment | Manufacturer | Model | Description |
|---|--------------------------------|---|--|
| Optical Loss Return Loss Test Set | EXFO | FOT-913-12D-32 or current model • Multi-mode | Dual Wavelength 850/1300 nm LED source with STII® connector and InGaAs detector. |
| | TTC | 462L or current model • Single-mode | Dual Wavelength 1310/1550 nm Cooler LASER with HRL faceplate connector and InGaAs detector. |
| OTDR | TEKTRONICS | • TFP2 or current model FiberMaster | |
| | | FM8513-Option 24 or current model • Multi-mode | Dual Wavelength 850/1300 nm source with STII® PC connector |
| | | FM1315-Option 34 or current model • Single-mode | Dual Wavelength 1310/1550 nm source with STII® PC connector |
| Optical Interferometer | Direct Optical Research Co. | Portable or Bench | Portable/bench video microscope with interferometer |
| | Norland Products Inc. | Portable or Bench | Portable/bench video microscope with interferometer |
| Copper CAT 6 Cable Tester | FLUKE | DSP-4000 | Multi-function tester |

NOTE:

1. Copper cable testers must meet EIA/TIA TSB-67 Level 2 requirements (pending). Known equivalents are available from Microtest and Scope Communications, all with latest available software revisions.
2. Optical cable testers must have preferred sources and detectors as listed above. Attenuation must have an accuracy within plus or minus 0.25 dB, and reflectance within plus or minus 0.5 dB. Submit specifications on desired equivalents for review and approval before using them.

APPENDIX A

Obtain the appendix, Label and Wiring Details, from Sandia's Telecommunications Department. It is too large to include with this specification.

APPENDIX B

Obtain the appendix, Cable Test Form, from Telecommunications Department. It is too large to include with this specification

GLOSSARY

ABBREVIATIONS

| | |
|-------|---|
| CCHD: | Corporate Computing Help Desk |
| CSI: | Cable Systems International |
| DOE: | United States Department of Energy |
| EMI: | Electrical magnetic interference |
| IDR: | Intermediate distribution room |
| LA: | Link attenuation |
| LIU: | Lightguide interconnection unit |
| LRL: | Link return loss |
| MDR: | Main distribution room |
| NEC: | National Electrical Code |
| NFPA: | National Fire Protection Association |
| NIST: | National Institute of Standards and Testing |
| NVP: | Nominal velocity of propagation |
| OF: | Optical fiber |
| OTDR: | Optical time-domain reflector |
| PTS: | Protected transmission system |
| SCN: | Sandia Classified Network |
| SDR: | Sandia-delegated representative |
| SFM: | Sandia-furnished material |
| SON: | Sandia Open Network |
| SRN: | Sandia Restricted Network |
| TIPS: | Tamper indicating prismatic seals |